portion between the compartments, wherein the first and second compartments are in fluid communication;

each vertical compartment including an upper fluid inlet port located in the top of the compartment, the inlet ports being in fluid communication with the interior of the compartments and an external fluid source;

each vertical compartment being equipped with an upper bed disposed inside each compartment, the beds being proximate to the upper end of the compartments and below the inlet ports;

the upper beds having fluid distribution nozzles, wherein fluid received from the inlet ports is directed into the compartments at a controlled flow rate;

each compartment further including an outlet port for backwashing, each outlet port being disposed adjacent to and below each upper bed, wherein the outlet ports remove particulate matter larger than the upper bed nozzle openings;

the U-tube portion between the compartments including a lower fluid inlet port, wherein the lower fluid inlet port is in fluid communication with both the first and second vertical compartments; and;

an ion exchange resin layer disposed within each vertical compartment, wherein a free board is defined between a top level of the ion exchange resin layer and the upper bed in each compartment, whereby the free board allows the resin layer to expand and contract during the liquid separation process.

7. The liquid separation apparatus of claim 6, wherein the vertical compartments further include a sight glass for monitoring the level of the resin layer.

8. (Amended) A liquid separation process performed by the apparatus of claim 6, wherein the inlet and outlet ports are in fluid communication with a service fluid supply, a regenerant fluid supply, a backwash fluid supply, and a pump for pumping the service fluid, regenerant fluid, and backwash fluid through the apparatus; the process comprising the steps of:

pumping service fluid through the inlet port of the first compartment down through the ion exchange resin layer of the first compartment and up through the ion exchange layer of

the second compartment, the filtered fluid exiting the apparatus through the inlet port of the second compartment;

regenerating the ion exchange resin layers by pumping regenerating fluid though the inlet port of the second compartment down through the ion exchange resin layer of the second compartment and up through the ion exchange layer of the first compartment, wherein the regenerant fluid exits the apparatus through the inlet port of the first compartment; and

backwashing the apparatus when the pressure drop of the service fluid increases to a predetermined level.

9. The liquid separation process of claim 8, wherein the step of backwashing when the pressure drop of the service fluid reaches a predetermined level, comprises:

backwashing the resin in the first compartment by pumping the backwash fluid at a controlled flowrate through the inlet port of the second compartment and outflowing the fluid through the outlet port of the first compartment; and

backwashing the resin at the second compartment by pumping the backwash fluid at a controlled flowrate through the inlet port at the first compartment and outflowing the fluid through the outlet port of the second compartment.

10. The liquid separation process of claim 8, wherein the step of backwashing when the pressure drop of the service fluid reaches a predetermined level, comprises:

backwashing the resin in the first compartment by pumping the backwash fluid at a controlled flowrate through the U-tube inlet port and outflowing the fluid through the outlet port of the first compartment; and

backwashing the resin at the second compartment by pumping the backwash fluid at a controlled flowrate through the U-tube inlet port and outflowing the fluid through the outlet port of the second compartment.

11. The liquid separation process of claim 8, wherein the step of backwashing when the pressure drop of the service fluid reaches a predetermined level, comprises:

opening simultaneously the outlet ports in both the first and second compartments; and